PATENT ABSTRACTS OF JAPAN

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(54) FUEL CELL SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent channels from being blocked by condensed water while preventing a voltage drop to the utmost.

SOLUTION: As shown in Figure (a)both fans F1F2 are driven so as to generate an air flow from the right to the leftthus sending air into all cells from the right to the left. Humidity and temperature increase with time within air channels. Cell voltage beings to drop as the humidity and temperature become uneven. The drop of cell voltage is periodically detected with respect to a fixed number of cells. If the detected value of any cell is lower than a set valuethe drive of the fan F1 is changed to generate an air flow from the left to the rightas shown in Figure (b). Furtherbased on the detected value of cell voltagethe drive of the fan F2 is changed to generate an air flow from the left to the rightas shown in Figure (c). Repetition of above operation to change the air-flow direction based on detected

cell voltage enables the humidity and temperature in the fuel cells to be uniformedand thus phenomena such as channel blocking by water can be beforehand prevented.

CLAIMS

[Claim(s)]

[Claim 1]A fuel cell system which is provided with the following and characterized by being constituted in a part of said two or more channel for oxidizer supplyor channel for fuel supply so that a circulation direction of an oxidizer or fuel may be changed.

A cell which equips with a cathode and an anode both sides of a matrix containing an electrolyte membrane thru/or an electrolyterespectivelyAndtwo or more channels for oxidizer supply being formed along with said cathodeand circulating an oxidizer along the channel concerned. A cell layered product which laminates a unit cell which equipped an anode with a fuel passage formation component which supplies fuel while two or more channels for fuel supply were formed along with an oxidizer passage formation component which supplies an oxidizer to a cathodeand said anode and fuel was circulated along the channel concerned.

An oxidizer feeding means which supplies an oxidizer to said each channel for oxidizer supply.

A fuel supply means which supplies fuel to said channel for fuel supply.

[Claim 2]The fuel cell system according to claim 1 which is provided with the following and characterized by being constituted so that a direction in which said first oxidizer feed mechanism supplies an oxidizer to the first passage groupand a direction in which the second oxidizer feed mechanism supplies an oxidizer to the second passage group may be changed individually.

The first oxidizer feed mechanism which supplies an oxidizer to the first passage

group as which said oxidizer feeding means was chosen from said two or more channels for oxidizer supply.
The second oxidizer feed mechanism which supplies an oxidizer to the second passage group selected from said two or more channels for oxidizer supply.

[Claim 3]The fuel cell system according to claim 1 which is provided with the following and characterized by being constituted so that a direction in which said first fuel supplying mechanism supplies fuel to the first passage groupand a direction in which the second fuel supplying mechanism supplies fuel to the second passage group may be changed individually.
The first fuel supplying mechanism that supplies fuel to the first passage group as which said fuel supply means was chosen from said two or more channels for fuel supply.
The second fuel supplying mechanism that supplies fuel to the second passage group selected from said two or more channels for fuel supply.

[Claim 4]Said first oxidizer feed mechanism consists of the first piping that connects said first passage group with the first fan and the first fan concernedand said second oxidizer feed mechanismThe fuel cell system according to claim 2 constituting so that it may consist of the second piping that connects said second passage group with the second fan and the second fan concerned and a blowing direction of the first fan and the second fan may be changed individually.
[Claim 5]The fuel cell system according to claim 4wherein said first piping and the second piping are formed by dividing with a partition member single space formed of an outer manifold.
[Claim 6]The fuel cell system according to claim 5wherein a water absorption member is provided in said partition member.
[Claim 7]The first oxidizer feed mechanism which supplies an oxidizer to the first passage group as which said oxidizer feeding means was chosen from said two or more channels for oxidizer supplyBy consisting of the second oxidizer feed

mechanism which supplies an oxidizer to the second passage group selected from said two or more channels for oxidizer supplyand changing selection of the first passage group in two or more channels for oxidizer supplyand the second passage groupThe fuel cell system according to claim 1 constituting so that a circulation direction of an oxidizer may be changed about some channels for oxidizer supply of two or more channels for oxidizer supply.

[Claim 8]The first fuel supplying mechanism that supplies fuel to the first passage group as which said fuel supply means was chosen from said two or more channels for fuel supplyBy consisting of the second fuel supplying mechanism that supplies fuel to the second passage group selected from said two or more channels for fuel supplyand changing selection of the first passage group in two or more channels for fuel supplyand the second passage groupThe fuel cell system according to claim 1 constituting so that a circulation direction of fuel may be changed about some channels for fuel supply of two or more channels for fuel supply.

[Claim 9]Said first oxidizer feed mechanism consists of the first piping that connects said first passage group with the first fan and the first fan concernedand said second oxidizer feed mechanismBy consisting of the second piping that connects said second passage group with the second fan and the second fan concernedand making space volume of the first piping and the second piping change. The fuel cell system according to claim 7 constituting so that a circulation direction of an oxidizer may be changed about some channels for oxidizer supply of two or more channels for oxidizer supply.

[Claim 10]When said first piping and the second piping are formed by dividing with a partition member single space formed of an outer manifold and the partition member concerned movesThe fuel cell system according to claim 9 constituting so that space volume of said first piping and the second piping may be changed.

[Claim 11]The fuel cell system according to claim 10wherein an absorptivity component is provided in said partition member.

[Claim 12]The fuel cell system according to claim 4 or 10 constituting so that a change of a blowing direction of said first fan and the second fan or movement of a partition member may be performed based on load current based on temperature of an outlet side of a channel for oxidizer supply based on cell voltage.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]Especially this invention relates to the system which generates electricity by reversing the circulation direction of the fluid into the channel for oxidizer supplyor the channel for fuel supply about a fuel cell system.

[0002]

[Description of the Prior Art]Generally the power generation system (fuel cell system) using a fuel cell reactionThe cell which equips with a cathode and an anode both sides of the matrix (it is hereafter called an electrolyte membrane generally.) containing an electrolyte membrane thru/or an electrolyteAnd the cell layered product which laminates the unit cell provided with the channel for oxidizer supply which supplies an oxidizer to said cathodeand the channel for fuel supply which supplies fuel to said anode is carried out with a subject. This is equipped with the oxidizer feeding means which supplies an oxidizer to each of said channel for oxidizer supplyand the fuel supply means which supplies fuel to each of said channel for fuel supply at least.

[0003]By the waywhen using the electrolyte of proton conductivityit becomes high by the oxidizer downstream especially (polymer electrolyte fuel cell etc.)and the concentration of the produced water produced by a fuel cell reaction becomes high by the fuel downstream especiallywhen using the electrolyte of oxide ion conductivity (solid oxide fuel cell etc.). Circulation of an oxidizer or fuel was

checked by the channel blockade by stagnation of this produced waterespecially condensation of produced waterand there was a problem that the reactivity of the downstream and by extensionthe reactivity of the whole cell fell. On the other handin order toprevent condensation of the moisture in the oxidizing agent passage downstream in a solid polymer type fuel cell system for exampleThe thing provided with the water-of-condensation elimination means which consists of a feed zone of unhumidified oxidant gas and water absorption material stored so that it might apply from this feed zone to a part of that upstream oxidizer feeding passage and a gas stream might not be checked in the middle of an oxidizer feeding passage is proposed (JPH6-89730A). Howeverin the field before and behind the feed zone of unhumidified oxidant gaswhile stagnation of produced water arose too in the downstreamthere was a problem that composition became complicated. On the other handa temperature gradient with the entrance side of an oxidizer and an outlet side is detectedand if it detects that the temperature gradient reached the specified valuethe fuel cell system which reverses the circulation direction of an oxidizer is proposed (JPH2-21102B). It is thought that this technology is effective for canceling stagnation of produced water. Since temperature distribution is equalized by reversing the circulation direction within the cell of an oxidizerthis is considered to be because for the concentration distribution of moisture to be equalized.

[0004]

[Problem to be solved by the invention]Howeverin this technologyan oxidizer supply direction is reversed by the whole cell layered product. For this reasonwhen the flow of an oxidizer became unstable temporarily and changed a circulation direction in all the cellswhile the fall of big output voltage aroseit had the influence on a life. Thenthis invention is made as a result of examining these SUBJECT wholeheartedlyIt is made for the purpose of providing the fuel cell system which can be attained suppressing the fall of the voltage at the time of reversing the circulation direction of an oxidizer or fuel for SUBJECT called the blockade of the channel by the water of condensation as much as possible.

[0005]

[Means for solving problem]In order to solve an aforementioned problemthe fuel cell system of this inventionThe cell which equips with a cathode and an anode both sides of the matrix containing an electrolyte membrane thru/or an electrolyterespectivelyAndtwo or more channels for oxidizer supply being formed along with said cathodeand circulating an oxidizer along the channel concerned. The cell layered product which laminates the unit cell which equipped the anode with the fuel passage formation component which supplies fuel while two or more channels for fuel supply are formed along with the oxidizer passage formation component which supplies an oxidizer to a cathodeand said anode and fuel is circulated along the channel concernedIt has an oxidizer feeding means which supplies an oxidizer to said each channel for oxidizer supplyand a fuel supply means which supplies fuel to said channel for fuel supplyand in a part of said two or more channel for oxidizer supplyor channel for fuel supplyit is constituted so that the circulation direction of an oxidizer or fuel may be changed.

[0006]The first oxidizer feed mechanism which supplies an oxidizer to the first passage group chosen from said two or more channels for oxidizer supply in said oxidizer feeding means hereIt constitutes from a second oxidizer feed mechanism which supplies an oxidizer to the second passage group selected from said two or more channels for oxidizer supplyIt can constitute so that the direction in which said first oxidizer feed mechanism supplies an oxidizer to the first passage groupand the direction in which the second oxidizer feed mechanism supplies an oxidizer to the second passage group may be changed individually.

[0007]Said first oxidizer feed mechanism is constituted from the first piping that connects said first passage group with the first fan and the first fan concerned hereSaid second oxidizer feed mechanism can be constituted from the second piping that connects said second passage group with the second fan and the second fan concernedand it can constitute so that the blowing direction of the first fan and the second fan may be changed individually.

[0008]Hereit can form by dividing with a partition member the single space formed of the outer manifold in said first piping and the second piping. Herea water absorption member can be provided in the partition member concerned. The first oxidizer feed mechanism which supplies an oxidizer to the first passage group chosen from said two or more channels for oxidizer supply in said oxidizer feeding means hereBy constituting from a second oxidizer feed mechanism which supplies an oxidizer to the second passage group selected from said two or more channels for oxidizer supplyand changing selection of the first passage group in two or more channels for oxidizer supplyand the second passage groupIt can constitute so that the circulation direction of an oxidizer may be changed about some channels for oxidizer supply of two or more channels for oxidizer supply.

[0009]Said first oxidizer feed mechanism is constituted from the first piping that connects said first passage group with the first fan and the first fan concerned hereConstitute said second oxidizer feed mechanism from the second piping that connects said second passage group with the second fan and the second fan concernedand by making the space volume of the first piping and the second piping change further. It can constitute so that the circulation direction of an oxidizer may be changed about some channels for oxidizer supply of two or more channels for oxidizer supply.

[0010]Hereby having formed by dividing with a partition member the single space formed of the outer manifold in said first piping and the second pipingand moving the partition member concernedit can constitute so that the space volume of said first piping and the second piping may be made to change. Herean absorptivity component can be provided in said partition member.

[0011]The first fuel supplying mechanism that supplies fuel to the first passage group chosen from said two or more channels for fuel supply in said fuel supply means herelt can constitute from the second fuel supplying mechanism that supplies fuel to the second passage group selected from said two or more channels for fuel supplyand it can constitute so that the direction in which said

first fuel supplying mechanism supplies fuel to the first passage groupand the direction in which the second fuel supplying mechanism supplies fuel to the second passage group may be changed individually.

[0012]The first fuel supplying mechanism that supplies fuel to the first passage group chosen from said two or more channels for fuel supply in said fuel supply means hereBy constituting from the second fuel supplying mechanism that supplies fuel to the second passage group selected from said two or more channels for fuel supplyand changing selection of the first passage group in two or more channels for fuel supplyand the second passage groupIt can constitute so that the circulation direction of fuel may be changed about some channels for fuel supply of two or more channels for fuel supply.

[0013]Hereit can constitute so that change of the blowing direction of said first fan and the second fan or movement of a partition member may be performed based on load current based on the temperature of the outlet side of the channel for oxidizer supply based on cell voltage.

[0014]

[Mode for carrying out the invention][Embodiment 1] It explains concretelyreferring to Drawings for the solid polymer type fuel cell system built over below at an embodiment of the invention. Drawing 1 is an assembly figure of the cell unit 100 which constitutes the solid polymer type fuel cell system 1 (only henceforth "the fuel cell 1") concerning this embodiment.

[0015]As shown in this figurethe cell unit 100 to the one side side (drawing 1 the upper surface side) of the frame 10 of rectangular form. The cell 20 which arranges the cathode 22 and the anode 23 makes the seal members 61 and 62 placed between the solid polymer membrane 21and is located in itThe cathode side stream way board 30 with which two or more cathode side stream way 311 -- was formed in parallel from moreover is inserted inand the anode side stream way board 40 of the frame 10 with which two or more anode side stream way 400 -- was formed in the side (drawing 1 the undersurface side) in parallel on the other handand the divider plate 50 are inserted in and constituted. In drawing

1the anode 23 is in the back side of the solid polymer membrane 21and the dashed line shows it.

[0016]The cell 20 is held in the state where it was pinched with the cathode side stream way board 30 and the anode side stream way board 40and to anode side stream way 400 --. Fuel gas flows in the direction shown by a white arrow of drawing 1air flows in the direction shown with a bold arrow of drawing 1and power generation is made by cathode side stream way 311 -- in the cell 20. As fuel gasreformed gas which uses hydrogen gas or hydrogen as the main ingredientssuch as natural gaspropanebutaneand methanolcan be used.

[0017]Predetermined number lamination of this cell unit 100 is carried outthose both ends are pinched with the end plates 71 and 72 (refer to un-illustrating and drawing 3 in drawing 1) of a coupleand the fuel cell 1 is constituted. The frame 10 to a board of rectangular form in the center section for fuel-gas-flow Michikata of the one side side (drawing 1 the upper surface side). In order to insert in the above-mentioned cell 20 and the cathode side stream way board 30the notch 101 is formedand on the other handto a side (drawing 1 the undersurface side). The crevice 103 in which the anode side stream way board 40 and the divider plate 50 are inserted is formedand also in a center section of the notch 101. It is the form in which the window 102 was established so that the anode side stream way board 40 and the anode 23 could contactIt is produced by carrying out the injection molding of the plastic materialsuch as PPS (polyphenylene sulfide) system resinPET (polyester) system resinor conversion PPE (polyphenylene ether) system resin. If PPS system resin etc. are used in this wayit has sufficient endurance also for the around 100 ** elevated temperature at the time of cell power generation.

[0018]The crevices 101a21a61aand 62a into which the partition member 81 into which the outer manifold space by the side of a cathode is divided gets are formed in the flank of 1 of the notch 101 of said frame 10the solid polymer membrane 21the seal member 61and the seal member 62 (Drawings near side). To the upstream part which receives for fuel-gas-flow Michikata of the frame 10.

The manifold hole 112 of the couple for introducing the manifold hole 111 of the couple for introducing water from the outsidethe slotted hole 121 for it being open for free passage with thisand distributing water to anode side stream way 400 -- and fuel gas from the outsideThe slotted hole 122 for it being open for free passage with thisand distributing fuel gas to anode side stream way 400 -- is established. The manifold hole 113 of the couple for deriving fuel gas unreacted to a downstream outsideThe manifold hole 114 of the couple for deriving the slotted hole 123 and water for it being open for free passage with thisand discharging the fuel gas from anode side stream way 400 -- to the manifold hole 113 outsideThe slotted hole 124 for it being open for free passage with thisand discharging the water from anode side stream way 400 -- to the manifold hole 114 is established.

[0019]Each slotted holes 121-124 are formed in the direction which intersects perpendicularly with anode side stream way 400 --and the both ends correspond with each manifold holes 111-114. The solid polymer membrane 21 is a thin film which consists of perfluorocarbon sulfonic acid. The cathode 22 and the anode 23 are the layers of the predetermined thickness made from platinum support carbonand adhesion molding is carried out by the hotpress in the center section of the solid polymer membrane 21.

[0020]The passage substrate main part 310 is inserted in the frame 300and the cathode side stream way board 30 is constituted. The passage substrate main part 310 is a plate-like component which consists of a carbon porous bodyand channel 311 -- which circulates air is formed in the cathode 22 and the field (it is the undersurface at drawing 1) which counters.

[0021]The frame 300 is the form in which the window 303 was established in the monotonous center of rectangular formIt consists of plastic material and channel 302 -- for deriving channel 301 -- for introducing air into channel 311 -- and air from channel 311 -- is formed in the field (drawing 1 the upper surface side) of an opposite hand with the cathode 22 side. From the frame 10are a carbon porous body of the rectangular form of small size a littleand two or more anode side

stream way 400 -- is formed in parallel mutuallyand the anode side stream way board 40 is the channel 400. -- In betweenrib 401 -- is formed.

[0022]This anode side stream way board 40 consists of the center section 40a located in the fuel-gas-flow Michikata-oriented centerand the upstream part 40b and the downstream 40c which were installed from this center section 40aand is the rib 401 from the upstream part 40b and the downstream 40c in the center section 40a. -- Height is set up highly. And the portion 401a with this high rib fits into the above-mentioned window 102and contacts the anode 23 electrically.

[0023]Although omitted in drawing 1between the cathode 22 and the cathode side stream way board 30 and between the anode 23 and the anode side stream way board 40the charge collectors 24 and 25 which consist of carbon paper which gave ******** are inserted (refer to drawing 5). The divider plate 50 is an airtight vitrified carbon plate of size equivalent to the anode side stream way board 40It intervenes between the cathode side stream way board 30 and the anode side stream way board 40and the work which prevents the air which flows through cathode side stream way 311 --and the fuel gas which flows through anode side stream way 400 -- from carrying out the abouchement is madecarrying out conduction of both electrically.

[0024]In drawing 2131-134 are O ringsare caught in the slot for O rings (un-illustrating) formed in the state of surrounding the manifold holes 111-114 and the slotted holes 121-124 between frame 10 comrades in the assembly state of a fuel celland carry out the seal of this portion. Drawing 3 is a perspective view showing the overall composition of the fuel cell 1and operation operation. Herethe case where it operates using hydrogen gas as fuel gas is explained.

[0025]As shown in this figureat the time of operationthe fuel cell 1 is arranged so that the circulation way (cathode side stream way) of air may be horizontally suitable. And the outer manifold 80 for sending the air as oxidant gas into a cathode is attached in the flank of the layered product of a cell unit. In order to divide the outer manifold space formed by this outer manifold 80 into the first manifold space 82 and the second manifold space 83 which are two space

areasthe partition member 81 is constructed over the internal surface of the outer manifold 80 from the flank of a layered product. The partition member 81 is fixed to the wall surface concerned by the internal-surface side of the outer manifold 80and the layered product side of a cell unitIt is inserted in the divider plate insertion part 101b (refer to drawing 2) with which said each crevice 101a is connectedand is provided in the portion corresponding to the space where the rib which forms the channel 311 of air was extended. therebythe circulation direction of air is common for the channel 311 of air -- it is roughly divided into the distribution channel of two air. That isit is with the first manifold space 82the air path 311a which was open for free passagethe second manifold space 83and the air path 311b which was open for free passage (refer to drawing 1).

[0026]Nextit is made to correspond to each manifold space formed hereand two fan F1 and F2 are provided in the side attachment wall of the outer manifold 80. These fan F1 and F2 have the function to reverse the circulation direction of air. By doing in this waywhile the air separately supplied from the first manifold space 82 and the second manifold space 83 circulates the air path 311a and the air path 311boxygen is supplied to the cathode 22and it is discharged besides a cell from channel 302 --.

[0027]On the other handhydrogen gas is supplied to the internal manifold space which consists of the manifold hole 112 from the hydrogen gas bomb 2and water is supplied to the internal manifold which consists of the manifold hole 111 from the water pump 3. In [the water and hydrogen gas which were supplied are distributed to each cell unit 100and] each cell unit 100It is distributed to the upstream part 40b of the anode side stream way board 40 from the slotted hole 121 and the slotted hole 122and flows through anode side stream way 400 -- into the downstreamand supply of hydrogen gas to the anode 23 and moisturization of the solid polymer membrane 21 are performed.

[0028]The output of the water pump 3 measures the water pressure in the slotted hole 121 for water suppliesand it adjusts it so that this value may turn into a predetermined water pressure value. The supply pressure of hydrogen gas is

adjusted with the regulator 5. A 100000-100000mmH_2Oespecially 100 - 800mmH_2O grade is usually suitable for this pressure. On the other handthe pressure of the unreacted hydrogen discharged is adjusted with the regulator 6. As for this exhaust pressure powerit is preferred to adjust so that the fuel utilization rate in the fuel cell 1 may be not less than 90%.

[0029]Unreacted hydrogen gas which passed anode side stream way 400 -- is discharged besides a cell through the manifold hole 113 from the slotted hole 123and water which passed anode side stream way 400 -- is discharged besides a cell through the manifold hole 114 from the slotted hole 124. Thusfuel gas is discharged in the state where it separated from water of a liquid. For this reasonit is also possible to collect as it is and to reuse discharged gaswithout going via the liberating tank 4.

[0030]**** discharged from the fuel cell 1 and water which a steam contained during exhaust air condensed are recovered by the liberating tank 4. It is cooled with the condensator 7 and collected water is again supplied to the fuel cell 1 from the water pump 3.

[About detailed composition and an effect from the upper stream of an anode side stream way to a downstream] It returns to drawing 1 and the gas distribution board 12 is inserted in the slotted hole 121 for the above-mentioned water supplies via an O ring (un-illustrating) in the water distribution board 11 in an upstream part at the slotted hole 122 for fuel gas supply.

[0031]The fine pores 11a and the fine pores 12a are both established by the sheet metal of long shapethis water distribution board 11 and the gas distribution board 12 are arranged in contact with the upstream part 40b of the anode side stream way board 40and areand the fine pores 11a and 12a are established corresponding to all the anode side stream way 400 --. As an example of the moisture powder board 11 and the gas distribution board 12What established fine pores by etching to metal (stainless steel of SUS304 and SUS316 gradeTi steel) sheet metalor the sheet metal (aluminum$_2O_3$ etc.) made from ceramicsOr what established fine pores can be mentioned to the sheet metal (a polyester

systeman ABS systema PPO (par phenyl oxide) systema PPE systeman PPS systemetc.) made from a plastic.

[0032]each fine pores 11a and 12a are identical shape (for examplecircularan ellipse forma polygon) and the same sizeand their number is also the same (for exampleevery 1 per channeland every two pieces -- or three pieces are formed at a time.)

As for the thickness of the water distribution board 11or the aperture of the fine pores 11ait is desirable to set up so that moderate resistance (pressure loss) may arisewhen water passes the fine pores 11aand it is desirable to set up the aperture of 120 micrometers - 5 mmand the fine pores 11a for the thickness of a substrate within the limits of 20 micrometers - 3 mm practical.

[0033]Drawing 5 is the sectional view which disconnected the fuel cell 1 in accordance with the water supply channeland shows typically the situation of generation of the vapor-liquid mixture in a channela flowand discharge. Drawing 6 (a) and (b) shows operation operation of the fuel cell 1drawing 6 (a) is a figure showing the upper surface of the cell unit 100 typicallyand drawing 6 (b) is a figure showing the A-A' section typically.

[0034]Fuel gas is supplied for water to each anode side stream way 400 -- from the fine pores 12a from the fine pores 11aand a vapor-liquid mixture is generated. And when this vapor-liquid mixture flows through each anode side stream way 400 --supply of the fuel gas to an anode and moisturization of solid polymer membrane are performedand the work as a refrigerant which cools a cell is also achieved. The vapor-liquid mixture of anode side stream way 400 -- generated by the upstream part 40b has the tendency for a solution layer and a gaseous layer to be separatedwhen passing a cell and a corresponding portion first. That issince it flows after being drawn by water to the substrate 40 sidethe solution layer which mainly consists of water existing in the anode side stream way board 40 side and the gaseous layer which mainly consists of fuel gas and a steam having existed in the anode 23 (charge collector 25) sidesupply of fuel gas is efficiently performed to the anode 23.

[0035]Nextthe downstream also has further the tendency for this state where it dissociated to be maintained similarlyfrom a cell and a corresponding portion. Thereforesince the water by the side of liquid will not face but a gaseous layer will attend the slotted hole 123 sidealternative discharge of gas is efficiently performed from the slotted hole 123. On the other handwater passes directly under gas exhaust (slotted hole 123)flows downstream furtherand is discharged from a water outlet (slotted hole 124).

[0036][Explanation about the control action of the circulation direction of air] Nextthe control action of the circulation direction of air is explained using drawing 4. The following operations are systematically controlled by the control section which is not illustrated. a control section -- CPU and a control parameter (the following operations -- the cell voltage of a standard.) the function etc. which are specified by the base temperature of the outlet of airand the reciprocal of load current -- etc. -- it comprises a memorized ROMRAM which stores temporarily the detection value (the cell voltagedetection temperature of the outlet of airload current which were detected in the following operations)etc.

[0037]Drawing 4 (a) - (c) is a figure showing the control action of the circulation direction of air. At the time of operationby drawing 4 (a)it drives so that fan F1 and F2 both sides may generate airstream leftward from the rightand air is sent in leftward from the right all over a cell. And a cell and inside the channel of the corresponding airhumidity and temperature become high with timeand humidity and temperature become high most especially near the outlet of air. Cell voltage begins to fall with uneven-izing of such humidity and temperature. Thenthe fall of this cell voltage is periodically detected in the cell of predetermined number of sheetsand if a detection value kicks in which cell lower than a preset valuethe drive of fan F1 will be changed like drawing 4 (b) so that airstream may occur rightward from the left. Based on the detection value of cell voltagelike drawing 4 (c)the drive of the fan F2 is changed so that airstream may occur rightward from the left. By repeating based on the cell voltage which detected the operation which changes the circulation direction of the above airequalization of humidity

and temperature can be attained in a cellandtherebythe phenomenon of the blockade of the channel by water can also be prevented.

[0038]Thusthe Reason for the ability to suppress stagnation of water is explained in detail below. When it is circulating only in the fixed directiongenerally in a cell air in the entrance side of air. Since the comparatively dry air circulatesthe humidity of the portion is comparatively lowbut since distribution air is humidified with the produced water generated by the cell reactionit has the tendency for humidity to become high most near an outletas air circulates the inside of a cell. As for airtemperature becomes high gradually with the reaction fever of a cell reaction as an airstream way is circulatedand temperature becomes high most by an outlet side too. Thusnear an outletsince the air of heat and high humidity circulateswater will stagnate there easilyand as mentioned above as a resultthe outlet of air will be plugged up.

[0039]On the other handif the direction which passes air is changedsince comparatively low air circulatesa temperature comparatively dry in the outlet side to which humidity and temperature became high can also lower the humidity and temperature of the portion. Since will become a steamand it will be taken in the air which newly flows or it will be spread in the inner part of an airstream way even if water is beginning to stagnate in an outlet sidethe phenomenon of the blockade of the channel by water is prevented beforehand.

[0040]Nextaccording to a method of changing a circulation direction of the above-mentioned airthe following effects also do so. Namelyalthough it will be temporarily stagnated by airstream in the portion and a fall of voltage is produced when reversing a circulation direction of air on an airstream way (311a311b) which changes a drive of fan F1 and the fan F2and counters the cell upper part and the cell lower partSince field of the state compared with a case where a circulation direction of air is reversed at a stretch on an airstream way which counters the whole cell where airstream stagnates on the whole which is avoided and stagnates at a stretch decreases as mentioned by conventional technologythe degree is low.

[0041]By the wayif airstream stagnates in this waywhat influence does it have on a cell? A few is explained. If airstream stagnatesin a cell part to which air is not newly suppliedair will be consumed by riot and a cell reaction will not continue. And load current will concentrate on a cell part in which airstream remains a littleand a cell reaction will be locally performed actively within a cell. Thusif a cell reaction advances locallytemperature will become high locally from a cell reaction being an exoergic reactionand the worst will cause breakage of solid polymer membraneetc.

[0042]Thuswhen a phenomenon in which airstream stagnates occurs repeatedlya life of a cell will be made short-livedbut. According to this embodimentsince airstream is not reversed on the whole cell surface and the whole airstream way which countersload current concentrated on a cell when airstream stagnates that much also becomes smalland even if it reverses a circulation direction of aira battery life seldom turns into a short life.

[0043]In this embodimentsince the divider plate is inserted in the flank of the layered product of a cell in manifold spaceairtightness has been secured to some extent. Therebyalso when the pneumatic pressure in the classified manifold space is comparatively highthe circulation direction of air is reversed good.

[Embodiment 2] With the fuel cell concerning this embodimentexcept that the control method which changes the circulation direction of air differs from said Embodiment 1since other fundamental composition is the same as ita point of difference is explained.

[0044]Although the voltage of the cell of two or more sheets was detected and the circulation direction of air was changed in Embodiment 1 based on the detection valuethe temperature of the outlet side of air is detected and it changes here based on this detection value. That isas shown in drawing 7a total of the four thermoelectric thermometers 848586and 87 is installed so that a tip end part may come to the space where the air near a cell layered product circulates in the middle of the lamination direction of a cell layered product. This thermoelectric thermometer detects temperature by a tip end part. And this thermoelectric

thermometer detects the representation temperature of the outlet side of airand if a detection value becomes a predetermined temperature defined beforehandthe circulation direction of air will be changed.

[0045]By changing the circulation direction of air based on the temperature detected in this waybefore the fall of cell voltage occursinversion operation can be performed. That issince inversion operation was performed based on cell voltage in Embodiment 1the fall of a certain amount of cell voltage is not avoidedbut if controlling temperature is set up near the temperature to which cell voltage begins to fallbefore cell voltage begins to fallthe circulation direction of air will be reversed. If it does in this wayit will become possible to perform power generation which carried out nearby stability from Embodiment 1.

[0046][Embodiment 3] With the fuel cell concerning this embodimentexcept that the control method which changes the circulation direction of air differs from said Embodiment 1since other fundamental composition is the same as ita point of difference is explained. Hereoperation which changes the circulation direction of air is periodically performed based on the cycle which was able to be defined beforehand. Although a cycle may be defined by time fixedit is desirable to use the cycle to which the battery actuation conditions to change are specified as a parameter. It is desirable to carry out periodically with the cycle specifically specified according to the load current of a cell. That isthe load current of a cell is detected and the circulation direction of air is changed based on this detection value. At this timethe linear function (when load current is set to iotathey are cycle =1 / iotax constant) of the reciprocal of load current can be made into a cycle.

[0047]The change of the circulation direction of air based on load current is performed as follows. Immediately after detecting load current oncecomputing a cycle based on the detection value concernedand changing a circulation direction on the basis of the time of load current detection the cycleload current is detected again and a cycle is newly computed. And a circulation direction is again changed with the cycle which was carried out in this way on the basis of the time

of the change of a circulation direction performed previously being completedand was newly computed. Based on load currentthe circulation direction of air will be changed by repeating a series of operations called such load current detectionperiodic calculationand a circulation direction change. If there is no change in load currentthe circulation direction of air will be changed a fixed cycle.

[0048]Thussince battery temperature is highan inversion cycle becomes short at the time of the heavy load which circulation inhibition of air tends to generate by condensation of produced waterand stagnation and it can change repeatedly a short cycle if a cycle is set up based on load currentThe humidity and temperature in a cell can be made still more uniform. On the other handbattery temperature is lowat the time of the low loading which is a little harder to generate by condensation of produced waterand stagnation than the case where it is circulation inhibition of air at the heavy load timeconverselyan inversion cycle becomes long and the fall of the cell voltage generated temporarily can be prevented by changing a circulation direction.

[Embodiment 4] With a fuel cell concerning this embodimentexcept that a control method which changes a circulation direction of air differs from said Embodiment 1since other fundamental composition is the same as ita point of difference is explained.

[0049]Drawing 8 is an enlarged drawing showing composition of a layered product by which a cell unit of a fuel cell concerning this embodiment was laminated. As shown in this figurea cell unit which constitutes a fuel cell of this embodiment has the circular crevice 88 in accordance with the depth direction in an inlet part of the airstream way 301. And it is in contact with the partition member 90 which divides manifold space into said crevice 88 and which can be driven.

[0050]Drawing 9 is a perspective view showing overall composition and operation operation of a fuel cell of this embodiment. As shown in this figurein the fuel cell concernedthe shaft 89 is installed through a longitudinal direction (cell laminating direction) of the outer manifold space formation component 80 [near the side-

attachment-wall inner surface of the outer manifold 80]and the partition member 90 is attached in the shaft 89 concerned. Width (Drawings longitudinal direction) of the partition member 90 is set as the almost same value as a radius of said circular crevice 88and it is in contact with the movable end of an opposite hand into an attachment portion to a shaft in said crevice 88 of an inlet part of air. An end of the shaft 89 is connected with the motor 92 via the reduction gear 91. Inversion driving of the motor 92 is carried out the whole fixed cycle. The reduction gear 91 slows down revolving speed of a motor at a predetermined speed. And driving force of the motor 92 is transmitted to the shaft 89 via a reduction gearand the partition member 90 drives an attachment portion with a shaft circularly as a fulcrumafter the tip has contacted the crevice 88 (refer to drawing 8). In order to improve airtightness in manifold space to a portion of the shaft 89 and an outer manifold which contactsit is placed between a state with the pivotable shaft 89 in the packing 89a.

[0051]Thusalthough it is common in Embodiment 1 in dividing into the field of two manifold spacethe place fluctuated in the ratio of the partition region has a big difference. That issince the partition member 90 rotates circularlya volume ratio with the space areathe first manifold space 82and the second manifold space 83 into which manifold space was divided by the position of the divider plate is changed. And if the circulation direction of air by fan F1 and the circulation direction of the air by the fan F2 are fixed so that it may become a counter direction beforehandthe circulation direction of air can be reversed selectively. If the circulation direction of this air is changedsince the circulation direction of air will be changedonly the flow channel part of the air corresponding to a changed part of the space area for which the divider plate rotated in a certain timeand manifold space was classifiedThe cell part portion into which the flow of air stagnates turns into only a peripheral part with which the divider plate is in contactand it decreases further compared with the case where the field where airstream stagnates is Embodiment 1. Thereforeit will become still more remarkable than the case where the effect of preventing reduction of the voltage

produced in connection with changing the circulation direction of airand the effect of prolonging a battery life's life are Embodiments 1.

[0052]Hereit explains more concretely about the control action of the circulation direction of air using drawing 10. Drawing 10 (a) - (d) is a figure showing the control action of the circulation direction of air. At the time of operationfrom the leftrightwardfan F1 is always driving the fan F2 so that air may always be circulated leftward from the right. In drawing 10 (a)the partition member 90 is located so that the inlet part of the channel of the topmost air may be coveredand air is sent in leftward from the right all over a cell. and the thing which the partition member 90 rotates -- drawing 10 (b)drawing 10 (c)and drawing 10 (d) -- as -- many [the partition member 90 rotates one by oneand] -- the circulation direction of air is changed in the channel of ** and air.

[0053]As long as speed of rotation of the partition member 90 is within the limits which can equalize humidity in a cellwhich speed may be sufficient as it. The partition member 90 places a predetermined time intervaland you may make it make a predetermined distance stage target rotate it. That iscell voltage is detectable like Embodiment 1it can be made to be able to drive gradually based on the detection resultor representation temperature of an outlet side of air can be detected like Embodiment 2and it can be made to drive gradually based on the detection result. Howeversince a way always rotated a certain fixed cycle can control a circulation direction of air finelyan effect which makes humidity and temperature in a cell regularity becomes remarkable. Herea cycle which makes a divider plate drive can also be made into a cycle determined that the above-mentioned Embodiment 3 described based on load current to a cell.

[0054]A flow of air sent into such classified manifold space according to a ratio of manifold space classified can also be changed. That isdriving force of a fan which corresponds as a ratio of a classified manifold space area becomes large is heightenedand driving force of a corresponding fan is lowered as a ratio of a manifold space area classified conversely becomes small. A suitable quantity of air can be supplied by a channel of each air with this.

[0055]As for the partition member 90it is desirable to rotate in the state where it contacted so that the layered product of a cell and the airtightness in the classified manifold space could secure to some extent. Thereforeit is desirable to attach componentssuch as a rubber material which has elasticity in the portion which the partition member 90 and a layered product contact. furthermore -- the inside of a rubber material -- an elevated temperature -- it is desirable to use silicon rubber or EPDM (ethylene propylene diene rubber) for humid environment from a viewpoint that it is strongchemically and mechanically.

[0056][Embodiment 5] With the fuel cell concerning this embodimentexcept that the composition of a divider plate differs from said Embodiments 1 and 4since other fundamental composition is the same as ita point of difference is explained. Drawing 11 is a perspective view showing the composition of the partition member 93 used for the fuel cell of this embodiment.

[0057]As shown in this figurethe partition member 93 is the composition which the absorptivity component 93b made lay [firmly] so that the skeletal part 93a and the skeletal part 93a may be covered. The skeletal part 93a can be constituted from PPSand can constitute the absorptivity component 93b from a nonwoven fabric which consists of rayonfor example. By using the partition member 93 of such compositionthe water of condensation adhered and dropped in manifold space is absorbed. And the air sent into a cell with the water absorbed in this way is humidified. For this reasoneven if it reduces the water replenishing amount to a fuel cellit can fully humidify.

[0058][Others] Herethe advantage of changing the circulation direction of air like the above-mentioned embodiment is explained. Firstbased on a temperature gradient with the entrance side of an oxidizerand an outlet sideit cannot fully respond to the channel blockade by the water of condensation in the time of starting with low battery temperatureand low loading with the technology which changes the circulation direction of air like before.

[0059]On the other handlike the above-mentioned embodimentif the circulation direction of air is changed in constant period based on the temperature by the

side of cell voltage and an air outletthe battery temperature can fully respond to the channel blockade by the water of condensation like [at the time of starting and low loading]also when low. Nextworking example is described.

[0060][Working example 1] Based on said Embodiment 1the fuel cell was constituted as a fuel cell of working example 1. As a fuel cell of the comparative example 1the outer manifold formation component for air supply has been arranged only on the side of 1 of the cell layered product of the specificationand the fuel cell which installed one fan here was constituted.

[0061]As a fuel cell of the comparative example 2the outer manifold formation component for air supply and discharge has been arranged to the both side surfaces which the cell layered product of the specification countersand the fuel cell which installed the fan with possible making each outer manifold formation component reverse the one direction of air circulationrespectively was constituted. The specification in which the produced fuel cell is common is as follows.

[0062]

Electrode area : 100 cm^2 solid polymer membrane : Perfluorocarbon-sulfonic-acid anode catalyst : Pt support carbon cathode catalyst : The number of Pt support carbon cell laminations : Generating operation was performed for the above fuel cells on condition of the following 52 cell. Air was used for the oxidizerH_2 was used for fuelair was not humidifiedand fuel supplied ion exchange water to the cell directlyand performed internal humidification.

[0063]

Current density : 0.5 A/cm^2 fuel utilization rate : 95% oxidizer capacity factor : 55% airstream reversal conditions : Drop width of 10 mV (change [in / to the laminating order of a cell / the 1stthe 10ththe 20ththe 30ththe 40thand the 52nd cell]) of the cell voltage to reference voltage

Change of cell voltage was pursued at the time of generating operation. Drawing 12 is a figure showing the temporal value of the average value of cell voltage.

[0064]As shown in this figurewhile cell voltage became unstableby the comparative example 1voltage fell greatly with time. In the comparative example

2since the humidity distribution and temperature distribution in a cell will be equalized when the flow direction of an oxidizer is reversed if the drop width of cell voltage reaches a predetermined valuecell voltage returns. Howeverwhen making it reversedin order that oxygen may run short temporarilycell voltage falls rapidly temporarily.

[0065]Although there is change of minute cell voltage when making it reversed in the fuel cell of working example 1 to thesecompared with the comparative examples 1 and 2cell voltage is stable.

[Working example 2] Based on Embodiment 2the fuel cell was constituted as a fuel cell of working example 2. And it generated electricity on the same conditions as working example 1and change of cell voltage was pursued at the time of generating operation. It combined with said drawing 12 and the temporal value of the average value of cell voltage was shown.

[0066]in addition -- if the temperature detected with a thermo couple becomes a preset value in the fuel cell of working example 2 -- the circulation direction of air -- reversal ******** -- it is made like and generated electricity by moreover setting up the preset temperature near the temperature to which cell voltage begins to fall. As a resultas shown in drawing 12the power generation which carried out nearby stability from the fuel cell of working example 1 in the fuel cell of working example 2 was possible. This is as having mentioned above.

[Working example 3] Based on Embodiment 3a fuel cell was constituted as a fuel cell of working example 3. And it generated electricity on the same conditions as working example 1and change of cell voltage was pursued at the time of generating operation. It combined with said drawing 12 and a temporal value of average value of cell voltage was shown.

[0067]in addition -- making a linear function of a reciprocal of load current into an inversion cycle in a fuel cell of working example 3 -- a circulation direction of air -- reversal ******** -- it generated electricity by making it like. As a resultas shown in drawing 12power generation which carried out nearby stability from a fuel cell of working example 1 in a fuel cell of working example 3 was possible. Since a

change of a circulation direction of air is performed repeatedly a comparatively short cyclethis is considered because an effect which makes humidity in a cell uniform became more remarkable.

[0068][Working example 4] Based on said Embodiment 4a fuel cell was constituted as a fuel cell of working example 4. And it generated electricity on the same conditions as working example 1and change of cell voltage was pursued at the time of generating operation. It combined with said drawing 12 and a temporal value of average value of cell voltage was shown. The partition member 90 was controlled to move reciprocately by making 5 minutes into one cycle.

[0069]Although there is change of minute cell voltage with the fuel cell of working example 4 when making it reversed as shown in thisvoltage is more stable even if compared with working example 1. Since the airstream way portion whichas for thislacks air temporarily with reversal of airstream at the fuel cell of working example 4 is a field of one **it is because the fall of the cell voltage at the time of reversal is very small.

[0070][Working example 5] Based on said Embodiment 5the fuel cell was constituted as a fuel cell of working example 5. And it generated electricity on the same conditions as working example 4and the replenishing amount of the water under the conditions which demonstrate the same power generation performance as the fuel cell of working example 4 was measured. As a resultin the fuel cell of working example 5it was 350 mL/h to having been 500 mL/h in the fuel cell of working example 4.

[0071]To say nothing of not being limited to the above-mentioned embodimentthis invention can consider the following embodiments.

(1) It does not matter even if it installs in two sides which counter first even if it does not install fan F1 and F2 in the side of 1 of a cell layered product in Embodiment 1. In this caseit installs so that two circulation fields may be formed in the airstream way corresponding to two sides in which a cell layered product countersin a cell.

[0072](2) Nextin Embodiment 1although outer manifold space was classified into

two fieldsa space area which airstream reverses becomes narrowso that there are many these fields to classifyand since a cell part which lacks oxygen that much also decreasescell voltage can suppress a fall further.

(3) In Embodiments 1 and 3although outer manifold space was classified into two fields along a cell laminating direction of a cell layered productit is also classifiable in a direction along a cell laminating directionand the direction which intersects perpendicularly mostly. That isa channel of air corresponding to one cell cannot be classifiedbut a cell and a cell can also be classified. Since a circulation direction of air all is not reversed at a stretch as the whole layered product even if it does in this waya cell which lacks oxygen that much also decreases and cell voltage can suppress a fall.

[0073](4) Although each above-mentioned embodiment furthermore explained a case where a circulation direction of air sent into a cathode was reversedit is possible to reverse a circulation direction similarly about fuel sent into an anode.

(5) Finallyalthough a polymer electrolyte fuel cell was mentioned as an example and the above explanation explained itin a phosphoric acid fuel cell etc.it can carry out similarly.

[0074]

[Effect of the Invention]Since it is constituted in a part of said two or more channel for oxidizer supplyor channel for fuel supply according to the fuel cell system of this invention so that the circulation direction of an oxidizer or fuel may be changed as explained abovelt becomes possible to attain suppressing the fall of the voltage at the time of reversing the circulation direction of an oxidizer or fuel for the phenomenon of the blockade of the channel by the water of condensation as much as possible. As a resultit becomes possible to raise a life characteristic.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an erection diagram showing the composition of the cell unit of the basic building block of the solid polymer type fuel cell system concerning Embodiment 1.

[Drawing 2]It is the enlarged drawing of a layered product with which the cell unit after the above-mentioned assembly was laminated.

[Drawing 3]It is a perspective view showing the overall composition and operation operation of the above-mentioned polymer electrolyte fuel cell.

[Drawing 4](a) - (c) is a figure showing the control action of the circulation direction of air.

[Drawing 5]It is an important section sectional view of the above-mentioned polymer electrolyte fuel cell.

[Drawing 6]Operation operation of the above-mentioned polymer electrolyte fuel cell is showndrawing 6 (a) is a figure showing the upper surface of a cell unit typicallyand drawing 6 (b) is a figure showing the A-A' section typically.

[Drawing 7]It is a perspective view showing the overall composition and operation operation of a polymer electrolyte fuel cell concerning Embodiment 2.

[Drawing 8]It is the enlarged drawing of a layered product with which the cell unit of the polymer electrolyte fuel cell concerning Embodiment 4 was laminated.

[Drawing 9]It is a perspective view showing the overall composition and operation operation of the above-mentioned polymer electrolyte fuel cell.

[Drawing 10](a) - (d) is a figure showing the control action of the circulation direction of air.

[Drawing 11]It is a perspective view showing the composition of the divider plate used for the polymer electrolyte fuel cell concerning Embodiment 5.

[Drawing 12]It is a characteristic figure showing the measurement result of the cell voltage which is an experimental result of working example.

[Explanations of letters or numerals]

80 Outer manifold

81 Partition member

82 The first manifold space

83 The second manifold space

848586and 87 Thermoelectric thermometer

88 Crevice

89 Shaft

89a packing

90 Partition member

91 Reduction gear

92 Motor

93 Partition member

93a skeleton

93b Absorptivity component

F1 and F2 Fan